

LAB I

INTRODUCTION TO COMMUNICATION EQUIPMENT APPLICATIONS TO FOURIER SERIES

Lab is scheduled on Monday November 3rd; 3-5pm.

Circuit lab is located on the second floor of Bullard Hall

Mr. Jeffrey Knight will be directing the lab.

Attendance to the lab is mandatory.

One report per group will be due NLT Friday, November 14th.

**NAVAL POSTGRADUATE SCHOOL
Monterey, California**

**Introduction to PC based
Test Equipment
Section I**

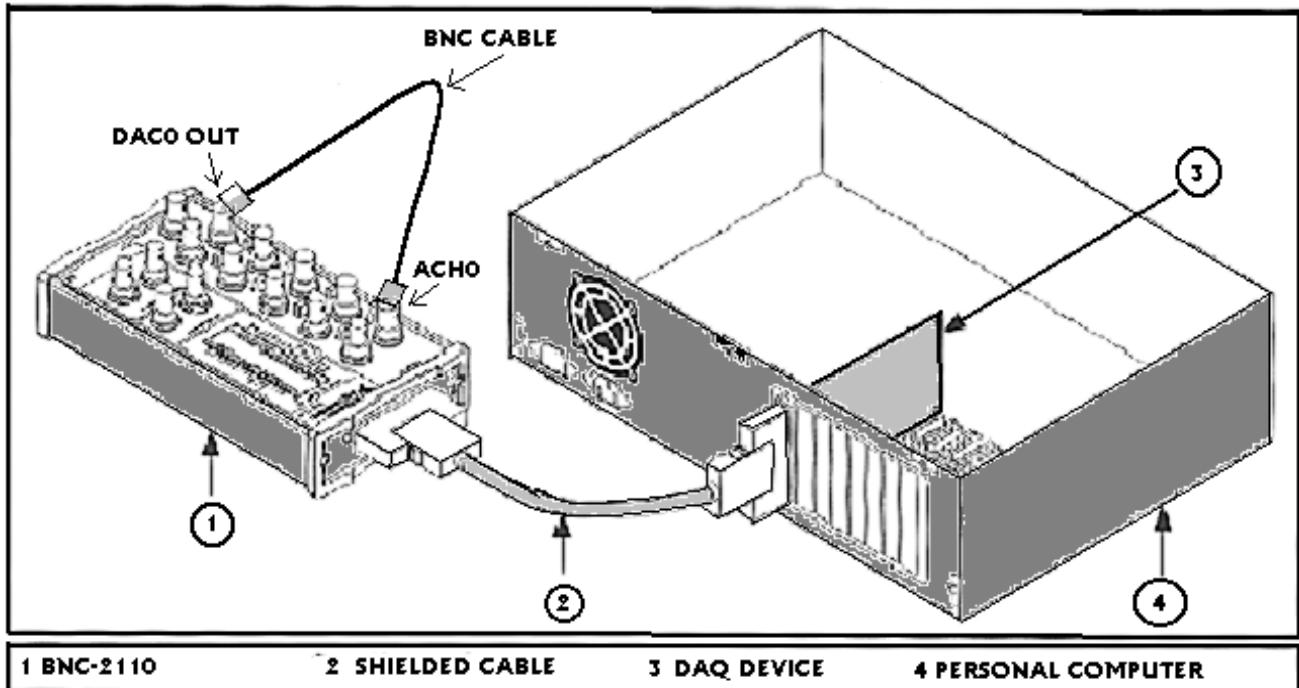
1. INTRODUCTION

This Lab is designed to familiarize you with the functional capabilities of National Instruments VirtualBench Data Acquisition Software. VirtualBench consists of stand-alone virtual instruments used with high speed I/O Multifunction Data Acquisition (DAQ) PCI boards.

2. EQUIPMENT

Personal Computer	PCI-6111E DAQ board (installed)
BNC-2110 BNC Adapter	
BNC Cable (1)	

3. PRELIMINARY SETUP



1. Connect BNC Cable as shown in Fig. 1. **Fig.1**
2. Double Click the VirtualBench Icon.
3. On VirtualBench Instrument Select Panel (ISP) double click the O-Scope icon.
4. Referring back to ISP double click the Function Generator (FG) icon.

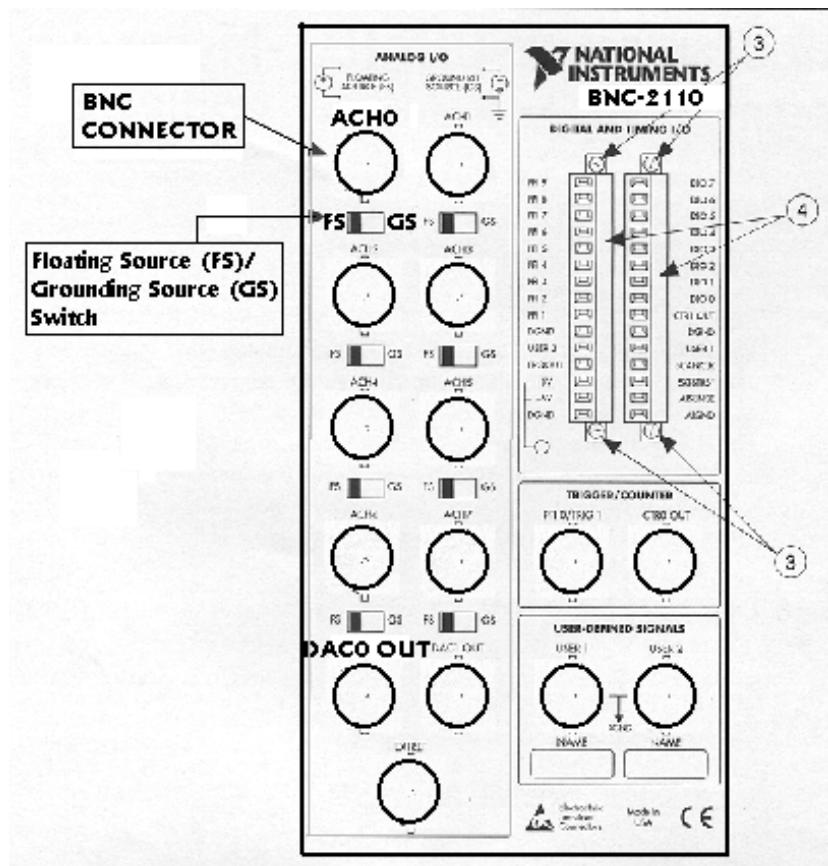
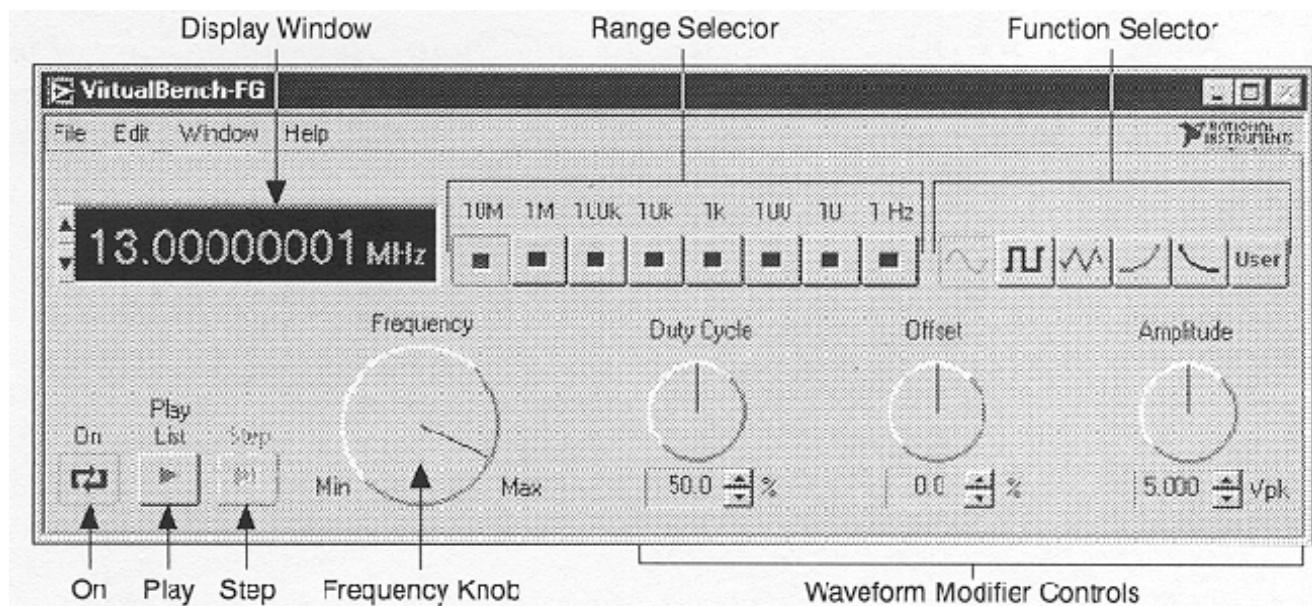


Fig. 1a

5. On the O-Scope and the Function Generator (FG) panel toggle ‘RUN’ or ‘ON’ button until button is highlighted. (Instruments are activated when ‘RUN’ or ‘ON’ buttons are highlighted.)
6. While holding down on left mouse button, position Vertical Slider to center of the display.

4. EQUIPMENT SETTINGS



Function Generator:

Range Select [100k]

Amplitude [1vpk]

Offset [0%]

Function [Sinewave]

Fig. 2

Frequency Knob adjusted for [10kHz] (Frequency can be typed directly into Frequency Display Window)
Duty Cycle [50%]

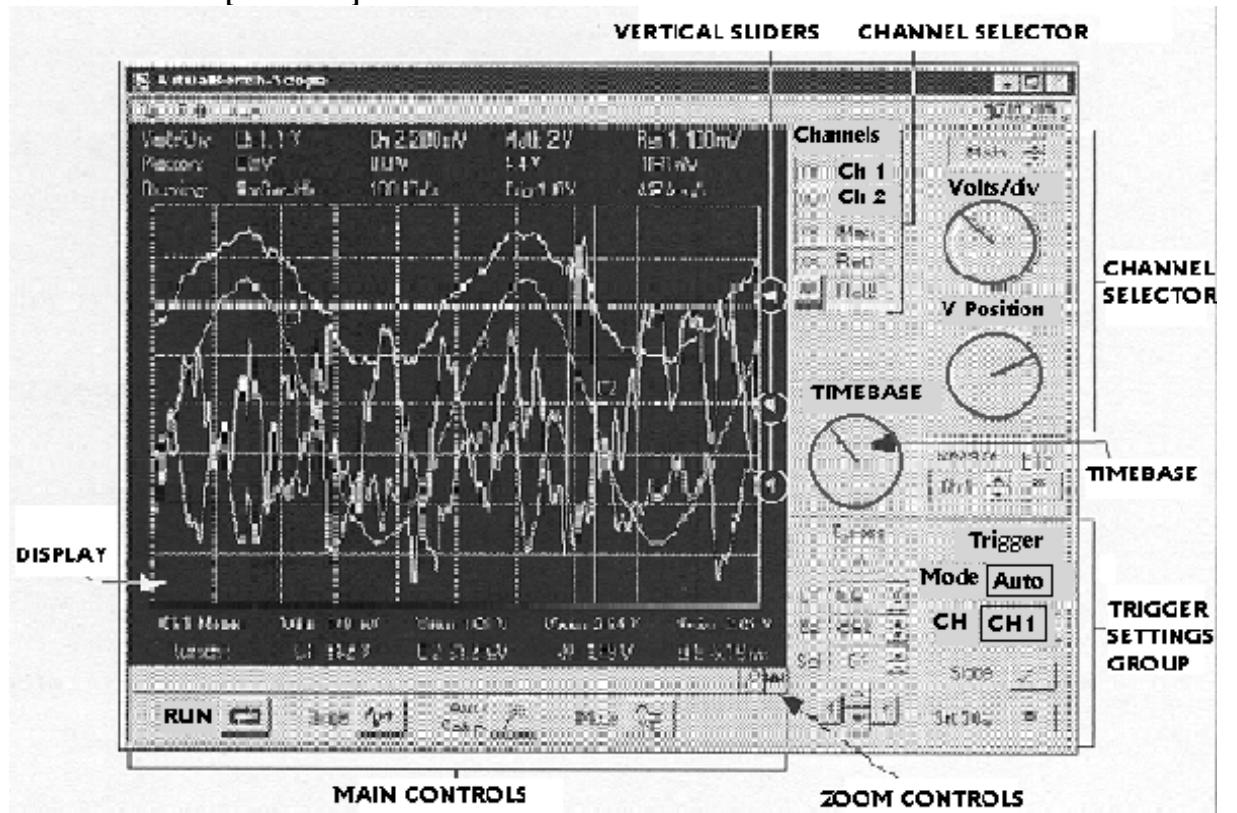


Fig. 3

O-Scope: (See Fig. 3)

Channel Selector [**Ch1**] (only)
Timebase [**50.0 μ s**]

Volts/Div [**500mV**]
Trigger Mode [**Auto**], [**Ch1**]

5. EXPERIMENT

Note: You should now be displaying a sinusoidal waveform on Ch1 of the Oscilloscope.

Oscilloscope:

1. Position Function Generator front panel to allow adequate viewing of Oscilloscope display.
2. Toggle Cursor control until [**highlighted**], set Cursor 1 (C1) and Cursor 2 (C2), as follows:
C1 [Ch1], C2 [Ch1].
3. Position mouse pointer over C1 and drag C1 cursor to top peak of Sinewave (Must hold down left mouse button to drag cursor), repeat for C2 cursor and place at second peak (one cycle). Use cursor select button and use fine tune cursor position controls (left-right arrows).
4. Record the values for ΔT , $1/\Delta T$, V_p .
5. On the Oscilloscope change the Volts/div from 500mV/div to [**1V/div**], vary the Timebase from $50.\mu\text{s}/\text{div}$ to [**10. μ s/div**] and observe the effects of these changes.
6. Return back to original settings: Timebase [**50 μ s/div**], Volts/div [**500mV/div**].

Function Generator:

1. On the Function Generator adjust DC offset to [**10%**] and observe the effects on the oscilloscope display. The average value of the sinewave should now be 1V with respect to ground. Ground on the Oscilloscope for Ch1 is referenced to the position of the Vertical Slider.
2. Change the Waveform Function from Sinewave to [**Squarewave**].
3. On the Function Generator adjust Duty Cycle to [**80%**] and observe the effects on O-scope.
4. Return back to original settings: DC Offset [**0%**], Duty Cycle [**50%**], Waveform [**sinewave**].
5. Change Amplitude to [**2Vp**] and observe the effect on O-scope, change back to [**1Vp**].

* Toggle ‘RUN’ button on O-Scope to stop acquisition (*Button should not be intensified*).

***Note** It is not recommended to run O-Scope and DSA simultaneously.

Dynamic Signal Analyzer (DSA)

1. On Instrument Select Panel (ISP) select the DSA icon to invoke Analyzer.

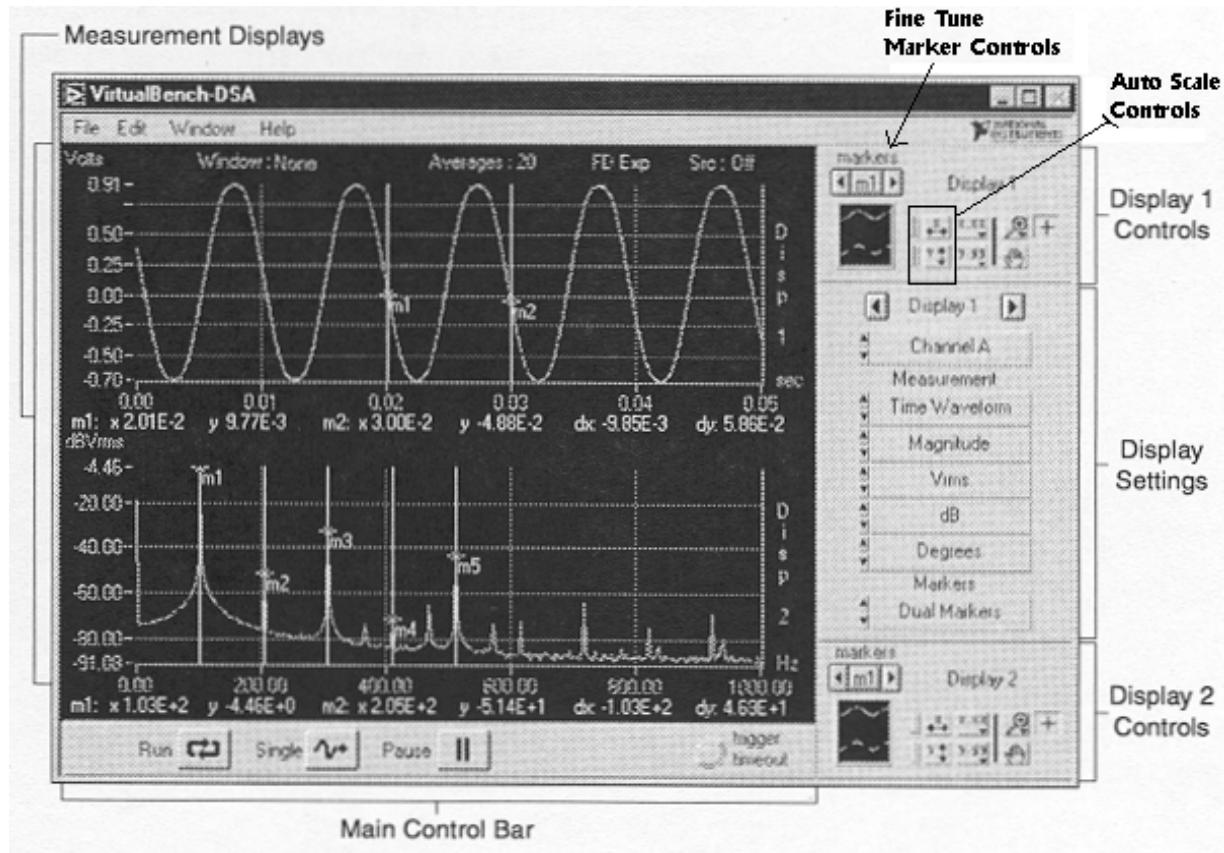


Fig. 4

2. Settings: (for Display 1)

[Display 1]

Measurement: [Amplitude Spectrum]
[Vpk]
[Degrees]

[Channel A]

[Magnitude]
[Linear]
[Markers Off]

* When Display 1 is selected all Display settings are related to Display 1 only.

(for Dispay 2)

[Display 2]

Measurement: [Amplitude Spectrum]
[Vpk]
[Degrees]

[Channel A]

[Magnitude]
[dB]
[Markers Off]

Access Edit Menu and select **Settings**.

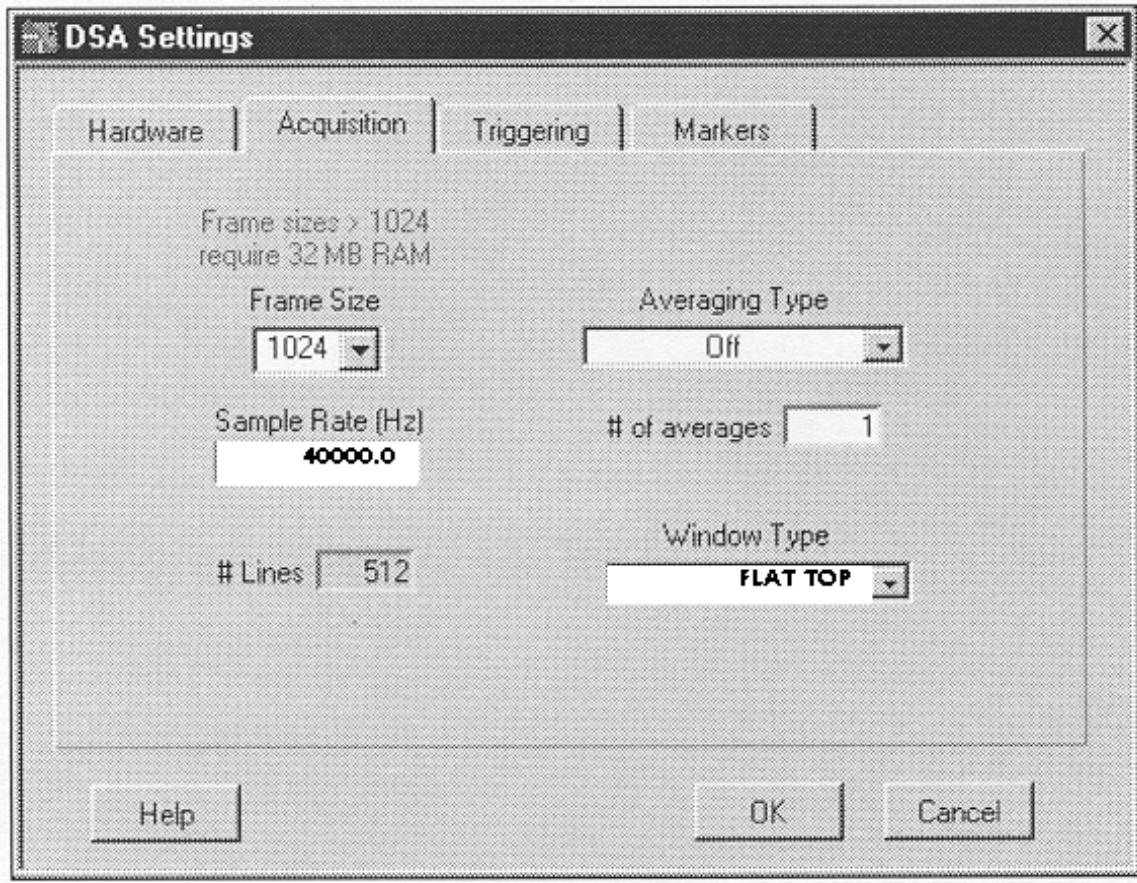


Fig. 5

Select **Acquisition** and make the following changes:

Frame Size [1024]

Sample Rate (Hz) [40,000]

Averaging Type [Off]

Window Type [Flat Top]

* Note full scale frequency range on Display will be equal to $\frac{1}{2}$ the Sample Rate.

3. Toggle 'RUN' button to Activate Signal Analyzer (*button should be intensified*). The Single sided Amplitude Spectrum of the Sinewave should now be displayed on Display 1 & 2.
4. Select [**Dual Markers**] for Display 1 & 2.
5. Drag marker **M1** to align with fundamental frequency for Display 1 & 2. Use marker fine Tune position control (left-right arrows) to place marker hash mark at peak of signal. Use Autoscale feature if necessary. (If signal is above the peak of the display).
6. Toggle '**Single**' button to activate Single Sweep Mode. (Pauses display and retains last values collected after sweep).
7. Record the frequency (x) and amplitude (y) values . Display 1 'y' value is the Linear Voltage representation and Display 2 'y' is the dB voltage value referenced to 1Volt. Verify the dB voltage ratio between the Linear voltage and the 1Volt reference. Compare with theory.

7. Select Edit window and choose Acquisition to change Sample Rate (Hz) to **[200,000]**.
8. On the Function Generator Select Waveform Function **[Squarewave]**.
9. Repeat steps 5 - 7 measuring all discerning harmonics.
10. On the Function Generator Select Waveform Function **[Triangle]**.
11. Repeat steps 5 - 7 measuring all discerning harmonics.

Write Up:

* Please keep Write Up under two pages.

- A. Compare theoretical and measured values for the amplitudes of the square and triangle waves.